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POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXVIII SAN FRANCISCO, FEBRUARY 10, 1912 NUMBER 6

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DESIGN OF HIGH TENSION TRANSMISSION LINES[1]

BY OTTO E. FALCH Jr.

Power transmitted over high tension lines is generally obtained from the natural flow of some river combined with artificial storage in reservoirs. In a plant of 2,000 ft. head, a flow of 1 cu. ft. per sec. represents 120 kw.-hr. or 30 cu. ft. of stored water per kw.-hr.

The design of these lines is generally based on the results of a thorough investigation of the requirements for each particular case. In a steel tower line of say 2,000 towers where every 100 pounds of unnecessary steel per tower represents a waste of approximately $10,000, the importance of the proper selection of spans between towers is apparent. This is especially more striking in hilly country than on level land. In hilly country the average span is generally longer than on level land when using towers of the same height.

After having the line properly surveyed and plotted in profile, the only way to secure a satisfactory line is to determine, step by step, the location of each tower, as shown in Fig. 1. First a catenary is drawn to the same scale as the profile and cut out of a sheet of heavy profile paper or other material.

Starting with the tower A at the top of the hill and placing the catenary as shown it is seen that the lowest point of the catenary is not always the nearest point to the ground.

Point E is the lowest point of span AB, but G is the point of minimum clearance. G determines the location of the next tower B.

The minimum clearance varies between 20 and 30 ft., depending upon the location of the line. Thus

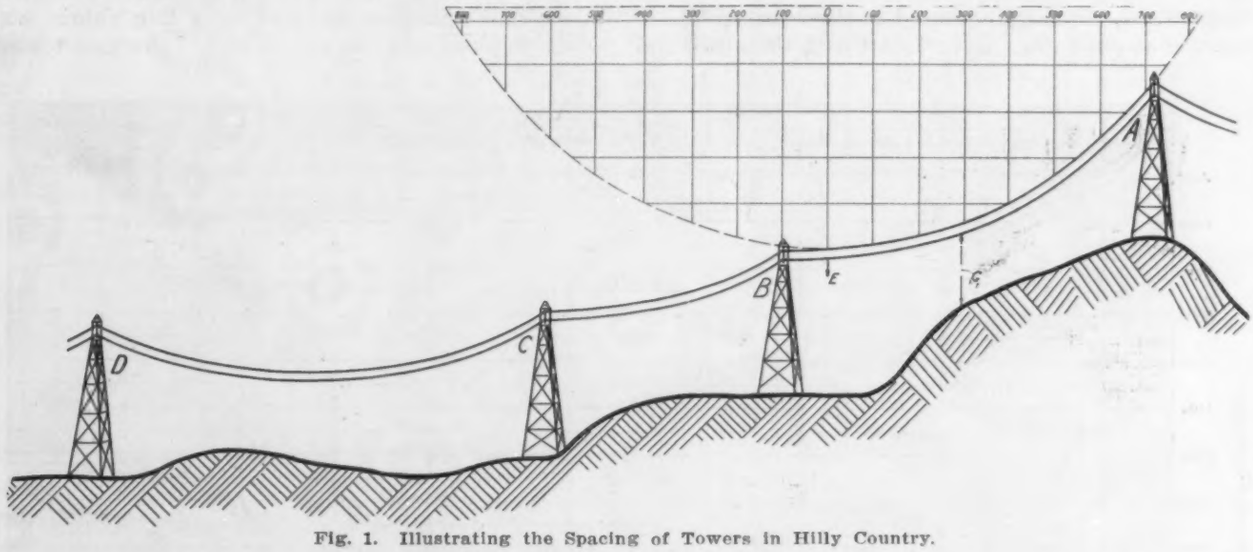


Fig. 1. Illustrating the Spacing of Towers in Hilly Country.

with a definite clearance, a predetermined tower height the points of support, A, B, C, etc., become fixed. The maximum sag, occurring at the highest temperatures met with, must be considered here with wind conditions disregarded.

But let us assume that a wind of maximum velocity is blowing at right angles to the line as shown in Fig. 2. In a long span AB, followed by a shorter span BC, the downward pull on the insulator at B is not sufficient to prevent this insulator from swinging through an angle such that the conductor is placed within a dangerous proximity to the steel tower, as is due to the resultant of the wind component on point 2. This is due to the resultant of the wind component on spans A B and B C being relatively large in

[1]Presented before the San Francisco Section of the A. I. E. E., Jan. 26, 1912.

comparison to the weight component, which is only that part of the span B C from B to the lowest point of the catenary in addition to a similar portion of span A B, the small part between B and E. So here we have another factor to consider in the spacing of the towers.

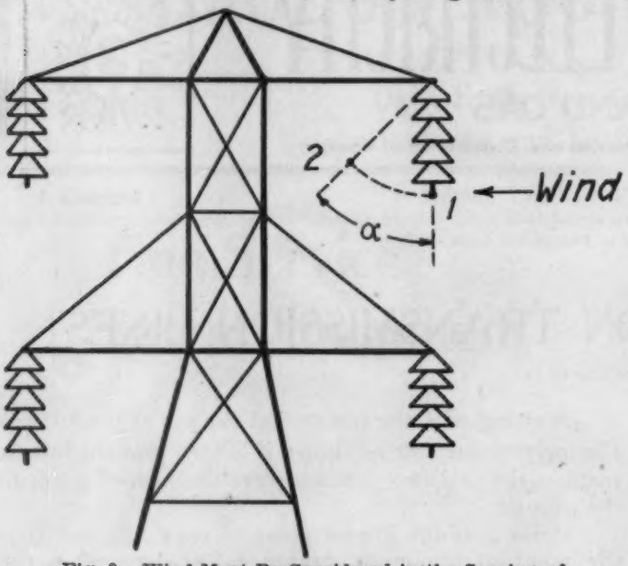


Fig. 2. Wind Must Be Considered in the Spacing of Towers.

Fig. 3 shows graphically the analysis of cable strains due to maximum conditions of load, wind and temperature. Spans are plotted as abscissae and cable tensions as ordinates. Let us start with the maximum allowable cable stress, which, of course, must be within the elastic limit of the material used. Taking a value of 25,000 lb. per sq. in. for copper we get a maximum value of 2,610 lb. for the specified cable. This is represented by the straight line A and may be taken as the horizontal tension. Similarly curve B represents the maximum horizontal tension at the insulator if it is assumed that the tension tangent to the catenary at the point of support is represented by the line A. The angle which the conductor makes with the horizontal at the insulator becomes greater as the span increases and thus an increase of the tangential tension in the line at the insulator over the horizontal tension at the middle of the span.

The next step is to plot the curve C, showing the tensions without wind or ice as the case may be at the same minimum temperature. The decrease in load on the cable results in a corresponding decrease in tension until a new deflection is reached where the tendency to contract due to the modulus of elasticity of the material balances the gravity stress in the cable.

In a similar manner, curves are plotted for the various changes in temperature by taking into consideration the coefficient of expansion. This results in a further decrease in tension due to the lengthening of the conductor and at the same time contract elastically due to this decrease in tension within the elastic limit resulting in a new deflection.

It is necessary to properly combine and substitute in various equations involved to obtain values with which to plot these curves. With the chart once made

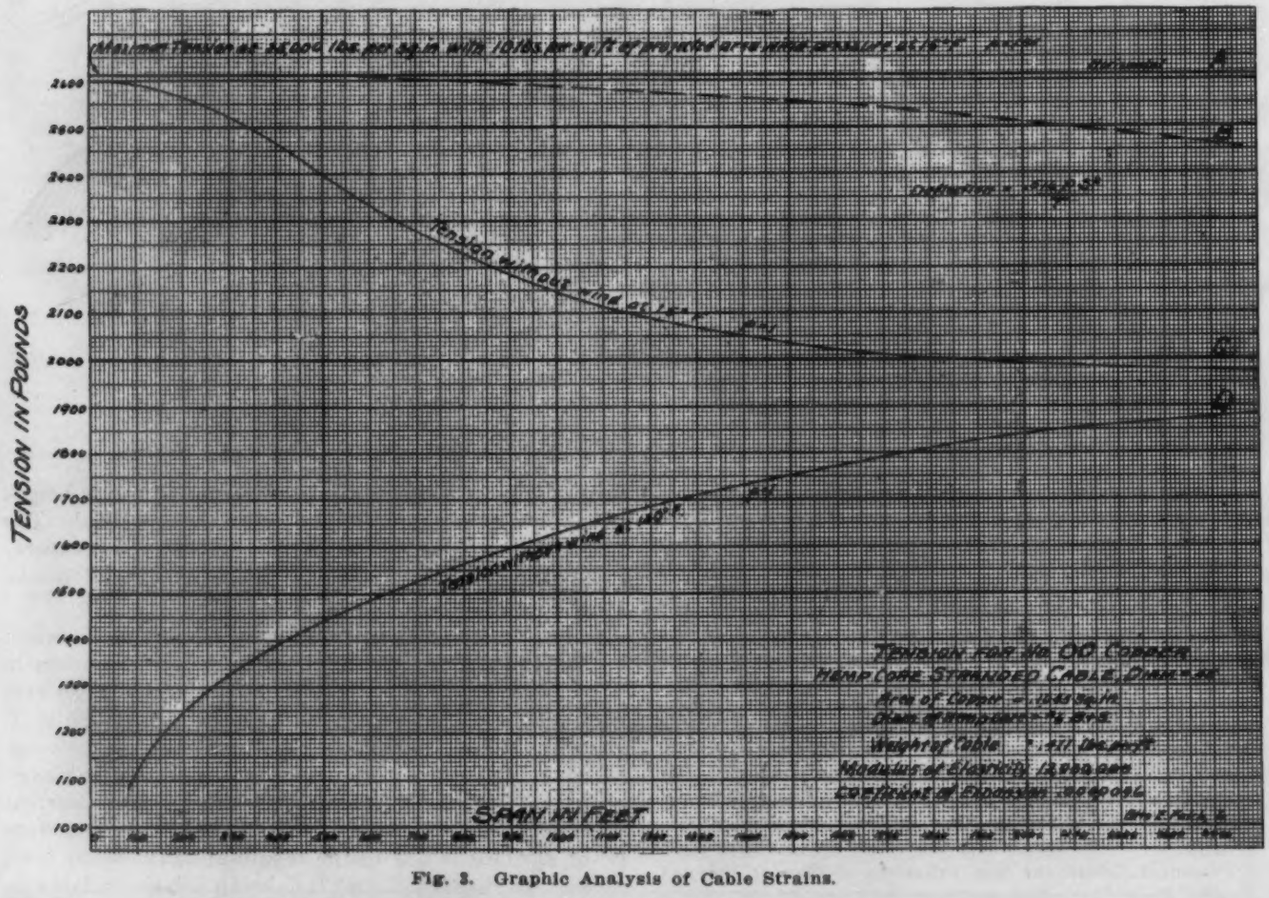


Fig. 3. Graphic Analysis of Cable Strains.

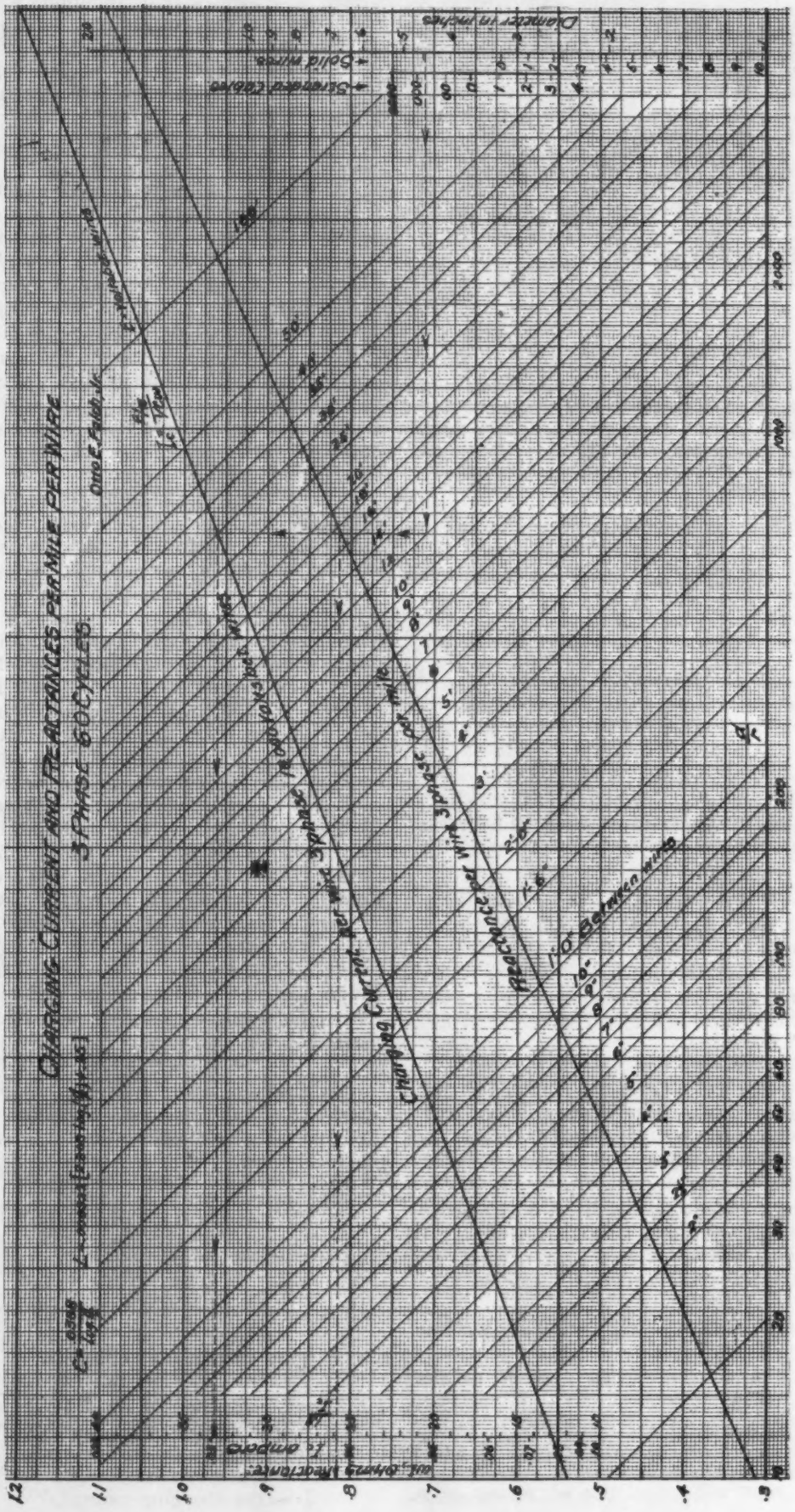


Fig. 4. Chart for Determining Charging Current and Reactance on Long Transmission Lines

the immediate use of all quadratic equations or of approximate methods can thus be avoided. An article covering the complete and exact solution of the equations of sag and tension, would be too long to include here. It is always well to have a check on the various approximate methods, when working out some important problem. For new conditions now arise with steel core aluminum cables in which the sag is less than with copper of the same conductivity as the steel carries the entire load at the higher temperatures similar to ice-covered cables. Let us, then, look into a particular illustration of the method involved.

The deflections corresponding to the tension shown in the curves are found from the equation $D = \frac{pwS^2}{8T}$, where p is the ratio of resultant weight of wire, ice, and wind to the weight of the wire, w is the weight of a foot of wire 1 sq. in. in cross-section which is 3.85 for copper and 1.155 for aluminum, S is the span in feet and D is the deflection in feet ∴ $D = \frac{.481pS^2}{T}$ for copper by substituting the value of $\frac{w}{8}$

For a No. 00 copper cable with a hemp core $D = \frac{.494pS^2}{T}$.

If the horizontal tension T^1 in the cable is used, instead of the tension T in lb. per sq. in., with no wind and ice $p = 1$, therefore $D = \frac{.05S^2}{T^1}$.

For aluminum cables $D = \frac{.145pS^2}{T}$ by substituting the value of $\frac{w}{8}$.

For steel cables $D = \frac{.427pS^2}{T}$ by similarly substituting the value of $\frac{w}{8}$.

For cables with steel cores as aluminum with steel cores, or copper clad wire, similar equations can be made for the different sizes of wire, taking into account the different proportion of the different metals.

In the selection of the proper size wire required for the power to be transmitted, the chart as plotted in Fig. 4 will be found to be very valuable in solving the problems for lines of considerable length, where the effect of line capacity becomes quite a question.

On this chart values of $\frac{d}{r}$ are plotted as abscissae, to a logarithmic scale, with values from 10 to 2000 where d represents the distance between conductors in inches and r the radius of the conductor in inches. On the right hand ordinate there is laid off, also to a logarithmic scale, the various sizes of stranded and solid wire cables in B & S gauge, with their corresponding diameters in inches. For special cables such as copper with hemp core or aluminum with a galvanized steel core the actual diameter in inches can be used.

The parallel straight lines making an angle of 45 degrees with the abscissae represent the distance between wires of from 1 inch to 100 feet, thereby covering a range of any spacing of wires that is liable to come up in problems even outside of transmission line calculation.

One of the ordinates at the left hand side marked I_c represents the charging current in amperes per mile per wire, 3 phase at 10,000 volts between wires. This is used in connection with the straight line marked Charging Current and is read diagonally across the entire chart. This curve becomes a straight line only when the values of the reciprocal of the charging current are plotted on the ordinate I_c to an evenly divided scale instead of the actual values. The reciprocals from 10 to 40 are marked on the right hand side of the line I_c and the actual values are shown on the left hand side ranging from one-tenth to twenty-five thousandths of an ampere charging current.

On the left hand ordinate, there is also plotted to an evenly divided scale the ohms reactance per wire, three-phase, to be used with the corresponding reactance line extending diagonally across the chart.

Suppose, as an example, we have a 104,000 volt three-phase line 136 miles long on which we are using a hemp core copper cable 45 hundredths of an inch in diameter with an average spacing of 12 ft. Start at the point .45 inches on the right hand side of the chart and then read horizontally to the left to the intersection with the 12 ft. spacing. From this point look vertically upward to the intersection with the diagonal line for charging current. Here we read at the left hand side the charging current and find it is equal to .0303 amperes per mile at 10,000 volts between wires. Therefore, the 136 miles at 104,000 volts the charging current is equal to 42.8 amperes at 60 cycles per second. This is equivalent to 7730 kilowatt amperes.

In the same way let us start from the right hand side of the sheet at .45 in. and note the intersection with the 12 ft. spacing. Looking upward to the intersection with the reactanace line, and then horizontally across the sheet, we read at the extreme left of the chart .815 ohms reactance per mile per wire at 60 cycles. For 136 miles this becomes 111 ohms.

Now with the triangle shown over Fig. 5 the characteristics of any transmission line can be determined. The method is a simplification of some of the older graphical ones.

Let $AB = -j\frac{I_c R}{2}$, the reactance drop due to the charging current over one wire.

$BC = \frac{I_c L\omega}{2}$, the resistance drop due to the charging current over one wire.

$CD = I \cos \theta R$, the resistance drop due to the power component of the load.

$DE = -j I \cos \theta L\omega$, the reactance drop due to the power component of the load.

Where I = the current in the line.

I_c = the charging current.

R = the resistance.

j = the letter used in solving equation by complex quantities to distinguish the vertical component from the horizontal component.

L = the self induction of the line.

$L\omega$ = reactance due to the self induction.

θ = the angle whose cosine is the power factor of the load.

Having found the values of these four quantites in percentage of the voltage at the receiver end, the rest of the solution is performed graphically by means of a triangle which is made of celluloid or other material. The base of this triangle MN is divided into any number of metric divisions depending upon the accuracy which is desired and is used as a scale for the remaining construction. Each of these divisions represents a value of one per cent. From a center O on NM extended, an arc MP of any convenient length is described with a radius of 100 divisions. For example, if one cm be taken as one per cent the radius of this arc becomes 100 cm.

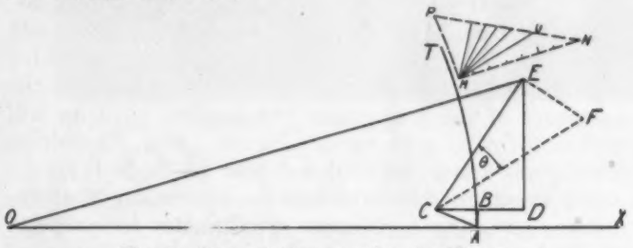


Fig. 5. General Construction for Fig. 6.

In the following example,—for a line of #00 B. & S. copper 136 miles in length, with a spacing of 12 ft. between wires, a resistance per wire of 56 ohms and with 20,000 kw. delivered; AB = 2 per cent, BC = 4 per cent, CD = 10 per cent, and DE = 20 per cent at unity power factor.

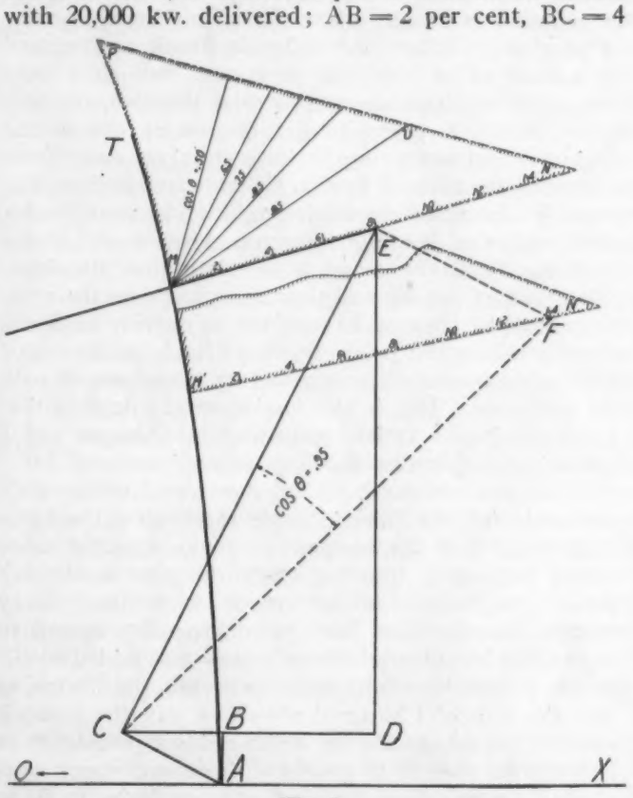


Fig. 6.

With my scheme it is not necessary for every problem that has to be solved to draw the arc AT with O as a center as shown in Fig. 5, if a triangle PMN shown in larger scale in Fig. 6 has been made having the arc MT cut to the same radius as AT, it is only necessary to draw on the line OX the arc AT with the arc MP of the triangle by placing MN along AX. Construct the right angle triangle ABC and CDE also with this triangle with AB = 2 per cent (2 units), BC = 4 per cent, CD = 10 per cent, and DE = 20 per cent.

Now place the arc MP of the triangle on arc AT so that the base MN passes through the point E. Here at E is read on MN 8 per cent, which is the regulation at unity power factor.

On our triangle with M as center are laid off several value of θ, that is $\cos^{-1}$ .95, .85, etc. For any other power factor as for example 95 per cent lay off angle ECF by placing MU along EC and obtain line CF. The length is determined by EF which is perpendicular to CE. As before, slide the arc MP of the triangle along AT until the base MN passes through F. We read a regulation of 14 per cent at a 95 per cent power factor.

In a similar manner examples have been worked out, thereby determining the characteristics of the Stanislaus line of the Sierra and San Francisco Power Company into San Francisco which check with actual tests at various loads and where we are operated at approximately 99 9per cent power factor.

Notice of Errata.

On page 89 of the Feb. 3, 1912, issue of this journal it is stated that the total interruptions to service on the Stanislaus transmission system for a period of fifteen months were twenty-four hours. This should read less than one hour.

In Fig. 6 a line should be shown at right angles to the base of the triangle inside the arc AT.

THE ELECTRICAL DEVELOPMENT LEAGUE.

Ninety-five members gathered at the newly organized Electrical Development League in San Francisco on Tuesday, February 6th, at the Press Club rooms. A month ago the total enrollment showed fifty-one members so that enthusiasm seems to be of a high order.

The program of the meeting was opened by an interesting paper on publicity which was read by James Redpath of the advertising department of the Southern Pacific Company. This paper is to be found below.

Then followed a debate on the question: Resolved, that it is the best interest of the central stations to sell incandescent lamps. Messrs. Holabird, Thieben, Carrigan and Stowe upheld the negative while Messrs. Leach, Neiman, Walton and Holberton battled for the affirmative. The discussion was thoughtfully listened to by all present. The judges, consisting of James Redpath, George J. Henry Jr., and Professor C. L. Cory, rendered a decision in favor of the affirmative.

The Publicity Committee displayed four separate ideas for general newspaper advertising and advanced new and suggestive methods of making this most effective. The discussion created a profound impression among the members. The report of the Publicity Committee is as follows:

We have in mind several forms of publicity campaigns, consideration of any one of which will occupy an entire meeting, and as others are to be heard from today we will pass them up for the moment and treat with the campaign suggested at a previous meeting—that of a weekly electrical newspaper page.

In laying out these pages it has been the object to have the illustrations so placed as to catch the eye, attract attention, and arouse curiosity or interest on the part of the reader in turning over the pages—objects which should be the foundation of all advertisements and especially ours.

Now as to copy. The magnitude and variety of the commodity to be dealt with we feel calls for the use of what is known as the "bulls eye" copy—that is—a few short, crisp facts that the eye involuntarily forces upon the brain of the reader with a minimum of effort rather than a congested mass of matter which few, if any, would take sufficient time to read, and if read—just long enough to determine the fact that it was an advertisement and then drop.

Each advertisement should carry a "reason why"—for example,—"Once hot—always hot,"—In other words reminding the housewife in a suggestive way of no more wood or coal fires to keep up while ironing,—no more hot stoves to stand over, or rooms to put up with, and consequent colds, and, incidentally, a saving in fuel bills.

Now this brings us to the point where we are going to be asked questions. This is what we hope to get out of our display advertising. It is the evidence to us that the public is getting interested. To take care of these inquiries we should have something with which to follow them up. This "follow-up" material should be in the form of booklets,—at least two in number; one that will give a reasonable amount of detailed information to the person interested in household articles for instance; the other, one that will satisfy building contractors, and architects,—that will indicate to them the simplicity and ease with which arrangements can be made in the construction of a house, whereby the various electrical labor-saving devices of the household may be installed.

You ask the question, "Does advertising pay?" We answer, "Properly, honestly and intelligently done,—yes." What would this great Western country of ours have amounted to if the builders of the first railroad, after completion of the line, had laid down and waited for business to come to them? Did they do it? No. They saw they needed business to make the road pay. To get this business they neded settlers. To get settlers they advertised.

And, gentlemen,—you are in the same boat. You have persevered until you have mastered the mighty giants of the Sierras and with a tiny copper thread have led them from their mountain strongholds to our very doors to perform our heavy labors; to move mountains; fill chasms,—that the world's great highways of commerce may be shortened; to help us home after the close of toil. Yes,—so humble have you made these mighty forces that they may be carried around in our pockets, done up in tiny packages, called on at will to guide our footsteps along dark paths.

How may others get better acquainted with these forces? ADVERTISE.

DINNER TO BION J. ARNOLD.

The San Francisco Section of the American Institute of Electrical Engineers gave a complimentary dinner on the evening of February 3d to Bion J. Arnold, past president of the Institute and engineer in charge of the traction study at San Francisco. About eighty members and guests were in attendance and a most enjoyable evening held.

The principal address of the evening was given by Mr. Arnold, the toastmaster being H. A. Lardner and other speakers Geo. C. Holberton, J. R. Bibbins and J. G. DeRemer. Mr. Arnold's address follows:

I suppose you are somewhat interested perhaps in the particular problem that I am here over. I want to say that San Francisco's problem I regard as quite a delicate one, at the same time a very interesting one. I hope to be instrumental in getting the various elements harmonized if possible upon some kind of settlement, if you may call it that, or some kind of a program which will allow the various discordant elements of the city to work harmoniously toward producing a street car service in the city which will be satisfactory to the citizens as well as to the operators of the properties, and in time such as will enable them to give service to the great Exposition which you are going to have here in 1915.

I stand on this principle fundamentally that the investments, the legitimate investments in property can and must be protected, that is, in privately owned property. What that investment is, is a question to be analyzed. It has been analyzed in other cities, and, of course, the view of the municipality as to the value of the investment, and of the corporation owning the investment, is usually at variance, but there is some value there. When the value is found and agreed upon, that value shall be protected in such a way that when the franchise shall expire the company will know that it is going to get that value out of the property, and not going to have it taken away from it simply because of the fact that the franchise has expired. In other words, it ought to be possible for the companies holding such franchises and for the municipality to agree on some date that the franchises will all expire, and that after that date the company shall be allowed to continue to operate until the city purchases the property, if it choses to do so, or till it makes some other satisfactory arrangement with the company. This is the fundamental principle that I am going on. It has succeeded in Chicago, and I am in hopes that the idea may succeed here.

I suppose you are all more or less familiar with the settlement in Chicago made there upon the basis of agreeing with the company in advance on the value of the properties, a price which the city would pay the company in case it ever saw fit to purchase. They found a certain price, and the municipality agreed to pay that price, plus whatever money was added to the property from time to time under certain conditions, so that the city of Chicago knows any day the price it would have to pay for its street railway properties in case it ever sees fit to purchase them, and it can purchase them any time it so indicates its desire to do so and pays the cash for them.

Now, the companies there can operate during the life of their franchises, and after the expiration of the franchises, if the city does not purchase, they can op-

Dinner to Bion J. Arnold

erate under the same conditions that obtain in the present provisions. So we worked it out in Chicago, I think, in a satisfactory way.

In Cleveland they have settled it in another way. They there settled upon an ordinance which was the outcome of the influence of ex-Mayor Johnson, now deceased, who introduced the three-cent fare idea there, fought for it many years, and finally succeeded in getting it adopted, and they, like Chicago, also agreed on a valuation of the properties, a price that the city should pay in case it ever purchased; but they went one step further, and stipulated that the company should only be allowed to make six per cent and no more upon this investment. We in Chicago, believed that did not give sufficient inducement to the owners and operators of the company to warrant the kind of service that we thought Chicago wanted, so we gave to the company the right to earn 5 per cent upon its investment, and 45 per cent of the net after the property was properly operated and maintained and renewed. The companies then pay to themselves forty-five per cent of the net that is left, and the city gets 55 per cent of that net. That gives to the company something besides a bare return upon the investment, and makes what we believe is an inducement or reward for good service and for proper operation of the property. Cleveland has that incentive lacking. It limits their profits to 6 per cent. In Chicago we give them 5 per cent, plus what they can make, which has amounted to 7 and 8 per cent, and in one instance 10 per cent, and in one 6 per cent, besides putting into the city treasury about two million dollars per annum out of the profits of the company.

Now, the Cleveland ordinance did not prove entirely successful. They were to operate for a period of eight months under the three-cent ordinance, that is, eight tickets for a quarter. The Cleveland ordinance stipulated that the citizens should have a three-cent fare, that is eight tickets for a quarter, so long as the company was able to operate and keep a reserve fund up to $300,000, this reserve fund being for the purpose of maintaining and renewing the property. Whenever the reserve fund drops below $300,000 then the fare was to be raised one cent per passenger, and when that reserve fund got up to $300,000 the fare was to be automatically reduced again a cent, so that this reserve fund acted as the surge tank for governing the fare that the citizens should pay, it being assumed that when it got to $300,000 the company was able to set aside enough for maintenance and when below that that it would not set aside enough. But in no event did the company get more than 6 per cent.

There was another provision in the ordinance, namely, that the companies could not sell securities except at par, and the city could not demand extensions. It was soon found that the company could not sell its security at par, and the city could not get any extensions. You got pretty crowded cars, and the service wasn't entirely satisfactory; so they have recently amended the ordinance which gives the company the right to sell its securities at something less than par. The discount, however, should be acceptable to the city. They have recognized you cannot always market a security, and they never did market a security on this property at par since the ordinance was passed.

There are other minor changes. One gives to the city the same authority by stating where the extensions should be, and they can demand extensions. They are acting now under the second trial period under this new ordinance. They don't know yet if they will be able to make the three-cent fare hold or not. They are charging a cent for transfers, which is returned to the passenger in case the transfer is not used. So they are under the second trial period of the Cleveland ordinance and we shall have to wait to see how it comes out.

We in Chicago believe that the Chicago idea is

better than the Cleveland idea, because it gives to the owner of the road an incentive over and above the bare return on its money. And those of you who are operating public utilities feel that you ought to have some reward besides an interest return on your money for staying on the job, because you can invest your money in a mortgage and get 5 and 6 per cent and not worry anything about it; but you cannot run a gas or electric property without some worry. You cannot even build them without worry.

Now, the question of franchise values is something that is being considered throughout the country. Those of us who organized companies twenty years ago, and some since, were disposed to and did place a value upon franchises, and rightfully enough we believed, because we judged properties not upon what they were really worth intrinsically, but upon what they could earn, that is, capital that they could earn a reasonable return on, and securities were sold on that basis. But in the last four or five years it has become, not fashionable (I will put it that way) to claim a franchise value because in many of the States they have laws which permit the State or municipality to regulate rates. Now, whenever a State or municipality has the right to regulate rates you can see that it is within its power to fix the rate so low that the advantage of having a franchise may be nil; consequently the franchise may have no value. Therefore, it is not wise to claim that it has a value, and few of us are claiming any more that it has a value, but we are rather standing upon the platform that we are entitled to earn a return upon the value of a property, plus a legitimate development expense, promotion expense, etc., but we are not claiming very much for franchise values, although we are claiming the right to live so long as the franchise exists, and claiming that we should make a liberal profit during the life of that franchise. I contend that any man or company that goes into a new field, creates a new enterprise, takes the chance of the thing being profitable or successful is entitled to something more than an ordinary return on his money. He is entitled not only to that return but he is entitled to a good liberal promoter's profit, if you please to call it that, or a good liberal profit of some kind to compensate him for having taken the risk of creating this property under new and adverse conditions. If you don't give to the individual or corporation, who takes those risks, that chance of reward, you are going to get no new properties created, no new inventions, nothing in the way of progressiveness that has tended so greatly and been instrumental in making this country what it is today, especially during the last twenty-five years, and especially in the field in which our energies have been directed. Suppose when these electric, light, power, gas and railroad properties were projected it was known that they would not be permitted to earn on their capital over 6 per cent, how many of you would have qualified yourselves as engineers to carry out your present occupations, or qualify to fill your present positions? It takes from you the incentive to do everything—I don't say anything—takes away from you what I considered the necessary incentive to develop new enterprises. I think that is being pretty well recognized by public utility commissions.

The Wisconsin commission has gone a step further, the Wisconsin State Railroad Commission, I believe it is called. They have gone so far as to say that the company, or individual, who has organized a company under such conditions and lost money on it from the start, is entitled to get that money back, plus a return upon it, and a reasonable promoter's fee and profit; and I believe that is a perfectly just proposition, namely, if you have gone in and created an enterprise, and operated it under adverse conditions in early years on the assumption you are going to be allowed to make large profits during subsequent years, I say, under these conditions when the public comes in and says, "We are going to regulate you, you cannot make these large profits that you anticipated," I say that the public should permit you to have an excessive profit during the subsequent years, or should reimburse you for your losses plus interests upon them, plus a reasonable profit for having created the enterprise. That position I am taking in the Buffalo reorganization. I don't know if we are going to get the State Commission to see it that way, but I believe we are. If that Commission acquiesces in that position the same as the Wisconsin State Railroad Commission has, it means one step further towards an equitable adjustment between the corporations and the public.

Now, the creation of those public enterprises in our cities such as subways, and tunnels, etc., it is pretty evident to me that these properties can be best created—not necessarily best created, but probably can be created the cheapest, upon the municipal credit, that is, upon some financial basis, which causes the city to get behind the created enterprise, even by lending its credit or by guaranteeing the bonds or even issuing city bonds upon it or issuing bonds upon the property backed by the city in some way. Mind you, I do not say that the municipality should operate that tunnel or subway, but I say you can create the property first cheaper upon city credit than upon individual or corporation credit, because a municipality can usually borrow money at a lower rate of interest than a private individual can, say half of one per cent, or some per cent lower. If it could borrow it as low as an individual can you can create the property as cheaply as the individual or corporation; if it can borrow the money at a lower rate than the individual you create the property for less—not create it for less but carry it on for less, because your fixed charges are less. To give service to the public for the least money, you want to get the benefit of the lowest fixed charges. That I believe can be done upon municipal credit better than by private credit. That is assuming, of course, that the money is honestly and properly spent by the municipality or by somebody for the municipality. That is the case also in creating a private enterprise, but the question of whether it is to be operated by the municipality or the private corporation is an entirely different thing, and I say you may lose all you have saved in the municipally created subway by improper municipal operation. I don't need to argue that question. You have got to operate a municipally owned public utility just as honestly as a privately owned one, or you lose all the advantages of the municipal credit behind it.

COMMENTS ON SHOW WINDOW LIGHTING.[1]

BY EDW. Y. PORTER.

Show window lighting may be divided into two general classes according to the kind of advertising desired, for it must be remembered that show windows and everything pertaining to them are primarily for advertising purposes.

The first class may be termed "spectacular lighting," the object being to draw attention to the window and store by means of the brilliancy, or novelty of the lighting effect as such, without special reference to the merchandise which may be displayed in the window.

The second class which we will call "merchandise display lighting" lays emphasis upon the goods displayed in the window, keeping the light sources concealed, or at least inconspicuous.

Spectacular show window lighting unquestionably has its place, but unfortunately it is all too often used, or misused, where it is decidedly out of place. Generally speaking, it is only permissible in the cheaper grade of stores and in small, shallow windows, or where a miscellaneous assortment of merchandise is dressed high in back of the window. Curio, Indian goods, novelty and toy stores may properly use exposed display lighting, provided always that the lights are of moderate candle power, and preferably frosted or enclosed in diffusing shades. The practice of hanging high power bare lamps, especially the 400 and 500 watt tungstens, in the middle of a window full of goods, is absolutely indefensible from any point of view; indeed it may properly be termed criminal, and should be prohibited by ordinance.

In large, high windows, a combination of spectacular and display lighting may be used which has some excellent features. If the plate glass is carried nearly to the ceiling line, a row of 25 or 40 watt tungsten lamps set 8 or 9 inches apart, pointing towards the rear lower corner of the window and equipped with prismatic glass reflectors, will give excellent illumination and at the same time afford a pleasing attraction in themselves, especially if there are a number of such windows in succession so that the light forms a long, unbroken line. From a distance such an arrangement will draw attention to the store, while upon nearer approach the height of the lights above the sidewalk renders them unobtrusive to the observer looking at the display of goods in the window.

The second class includes by far the greater part of properly lighted show windows. It may be laid down as a general fundamental rule of good window lighting that the flux of light should, as nearly as practicable follow the line of vision, and that the light sources should be entirely out of the line of vision. and so placed that the direct rays cannot strike the eyes of the observer while he is looking at the goods displayed in the window. The following of these rules usually requires that the lamps should be located along the upper front corner of the window. Preferably the lamps should be concealed behind woodwork, draperies or an opaque sign with translucent lettering painted on the glass at the window top.

It is important there should be some subdued shadows; to secure which, the light should come from one general direction, but to avoid too sharp shadows it should not come from a single source or cluster. A row of lights along the front of a window fulfills this requirement, except in the case of a window forming one side of a deep entrance vestibule. If the row of lights is carried along the upper edge of that part of the window facing the vestibule there will be cross lighting from two directions which may obliterate the shadows, and also most of the lamps will be exposed to view from the street. Both of these defects may be corrected by bunching the lights near the front corner, and using concentrating reflectors to throw the light down and back upon the goods in the rear part of the window.

Where the entrance vestibule is very deep as has recently become popular, the scheme mentioned above is impracticable, and proper light becomes a rather vexing problem, with several possible though not entirely satisfactory solutions.

One method would be to use lamps in deep opaque reflectors, preferably of the silvered mirror type. The objections are the unsightliness of the reflectors themselves, and that the ceiling of the window would be insufficiently lighted unless it were white or very light in color, in which case there would probably be sufficient reflection from the lower part of the window for ceiling illumination.

Lamps are sometimes set in pockets in the ceiling. This method if properly designed and carried out with suitable reflectors may be made to give excellent results, and from an artistic standpoint is nearly ideal. Opaque silvered reflectors, which may be of plain mirror glass built into the woodwork, should be used, and the pockets should be of such depth that the filaments of the lamps will not be visible at more than an angle of 45 degrees from the vertical. The above construction is expensive but would be fully warranted in a high-class installation.

A third and very satisfactory solution is to use prismatic or opalescent reflectors of sufficient depth to conceal the lamp filaments. This will give a more cheerful effect to the window and also probably be received more cheerfully by the proprietor on account of the smaller expense.

One of the most difficult windows to light with any degree of satisfaction is the high and wide but shallow windows frequently found along the side street frontage of clothing stores, especially if the windows are provided with a shelf.

Such windows usually have on display men's suits which, being dark in color, require a high intensity of illumination. Also they must necessarily be displayed in an upright position, and the suits nearest the front of the window are subject to the closest inspection and should have the highest degree of illumination, yet with the usual arrangement of lights there is practically no illumination except upon the upper surfaces.

The writer is of the opinion that the simplest and best method of treating such a condition is to put high powered lamps with weather proof fittings and reflectors entirely outside of the show windows. Some light will doubtless be lost by partial reflection from the surface of the plate glass, but the light will fall upon the

[1]Presented before the Los Angeles Section of the A. I. E. E., Jan. 23, 1912.

front of the merchandise as it should, instead of upon the top only. Care must be taken that the image of the lights reflected from the glass does not come within the line of vision of an observer.

The question of intensity of illumination is an open one. Within limits it is largely a matter of the condition of the merchant's exchequer or his desire to outdo or undo his neighbor.

Before the advent of the tungsten lamp few windows could be found in which the illumination at the front part of the window floor exceeded three or four lumens per ft. (i.e. ft.-candles), but within a year the standard had nearly trebled, so that at the present time a window with less than five lumens per sq. ft. can hardly claim adequate illumination for any but the lightest colored goods. Dark goods require upwards of ten lumens for good illumination, and in extreme cases, windows have been flooded with over one hundred lumens per sq. ft. Such extreme brilliancy is poor engineering because it is wasteful. The normal human eye is a very poor judge of the intensity of illumination for intensities much in excess of that under which the object viewed can be clearly and easily seen. For example, if a piece of silk can be clearly seen without special effort under an illumination of five lumens per sq. ft. an intensity of ten lumens would add but little, if any, to the attractiveness of the goods, and if the illumination were gradually raised from ten to twenty or more lumens probably not one person in a hundred would notice the change, though some might find it difficult to see clearly with the higher intensity due to the glare of the reflected light.

It goes almost without saying that the proper intensity is governed very largely by the color of the goods displayed. An intensity which would brilliantly illuminate a window full of light colored silks or table linens, would be entirely inadequate for a display of men's winter clothing or dark dress goods, therefore provision should always be made for using part or all of the lighting equipment of a window, and the equipment for maximum illumination should be proportioned to give clear vision for the darkest goods to be displayed in the window.

The choice of lamps, reflectors and fittings is a difficult matter to discuss in a meeting of this nature on account of the commercial aspect which such a discussion naturally assumes.

Among electric lamps the tungsten or Mazda has a practical monopoly of the field for show window lighting and properly so. For spectacular lighting the smaller units, 25 or 40 watts, will naturally be used, and in some cases with low voltage, 5 or 10 watt lamps may be used. Where lamps are partially or wholly concealed, economy will usually require the use of 60 or 100 watt lamps, and in very large windows or where extremely high intensities are sought the 400 or 500 watt units might be used to advantage.

Tubular lamps with tungsten filaments, as now made, labor under the disadvantage of being low voltage lamps and therefore requiring transformers or series connection. They have special advantages for showcase lighting and in low windows or to supplement general lighting in large or special windows. Windows having approximately the same depth as height, even though quite large, may be lighted by these lamps, but for high and comparatively shallow windows the distribution of light from them as ordinarily made, is too broad and does not carry far enough to reach the lower front part of the window where the light is most needed. This, however, is more dependent upon the reflector trough in which the lamps are mounted than upon the lamps themselves, and there is no vital reason why reflectors cannot be made for these lamps which will concentrate the light in any given direction even more accurately than can be done with the reflectors used on the ordinary bulb lamps.

Reflectors are the means by which the engineer is enabled to direct and control the light from his lamps, and special care should be used in selecting those best adapted to the particular installation in hand.

Considered as reflectors only, silvered glass is undoubtedly the most efficient, and reflectors of this material, either in one piece or built up of minor sheets, may be obtained in a variety of forms and sizes. Some of these are quite pleasing in appearance, but for the most part such reflectors are best suited for concealed lighting

For exposed lighting there are many forms of prismatic and opalescent reflectors available which are fairly good reflectors and also of pleasing appearance.

Nearly all progressive manufacturers of reflectors will furnish authoritative polar diagrams showing the distribution of light at various angles from their reflectors when used with the lamps for which they were designed. Such diagrams enable one to select a reflector suited to the particular case in hand. In making such selection it should be borne in mind that it is the goods near the front of the window which are subject to the closest scrutiny and therefore require the greatest intensity of illumination.

DISCUSSION ON SHOW WINDOW LIGHTING.

BY FREDERICK S. MILLS.

In the subject of proper show window lighting there is only one class which is figured from an engineering standpoint and not from a selling point of view, with the following peculiarities derived from the details taken into consideration: Height of the windows from floor to ceiling; length from riser to riser, or divisions in the plate glass windows; depth and color of finish of the wood work; the grades or color of materials to be displayed. With these factors determined the next step is to ascertain the proper number of foot-candles and power necessary to light the windows with the greatest efficiency. A foot-candle is a normal illumination produced by one unit of candle power at a distance of one foot and equals 10.764 meter candles.

Proper window lighting is always considered the most valuable asset of a merchant and, inasmuch as the expense of installing the wood work and back-ground with inlaid floors, is comparatively great, this precaution of selecting a lighting system should also be used in recommending the proper system of window lighting and number of foot-candles to be given, regardless of the first cost of the installation. A merchant depends largely upon his show windows, wall and show cases for a 20 to 35 per cent return on the profits of his business, as they are his salesman. Where a merchant will not stop at an expenditure in decorating windows and putting elegant finishes on the interior, why should he not be controlled by a standard on illumination?

The subject of spectacular window lighting is seldom considered from an engineering stand-point. Merchants who

are installing this system of window lighting are either unreliable firms, that is, considered as transient merchants, or they have no regard for the subject of proper illumination. The contractor installs so-called spectacular window lighting on specifications emanating from an architect's office or the merchant himself. The method of installing single units of 400 to 500 watt tungsten lamps in an 8 or 10 ft. high window, regardless of the depth or length, and also clusters of tungsten lamps, is far from securing a proper diffusion of light.

Mr. Porter states in his paper as follows:

"In large, high windows, a combination of spectacular and display lighting may be used which has some excellent features. If the plate glass is carried nearly to the ceiling line a row of 25 or 40 watt tungsten lamps, set 8 or 9 in. apart, pointing towards the rear lower corner of the window, and equipped with prismatic glass reflectors, will give excellent illumination." Here a mistake is often made by merchants in different classes of trade, in adopting the same system of lighting. Very little thought is given here for the class of material displayed and the color scheme. For instance, we must consider the amount of light reflected from the goods and background to reach a definite figuring basis.

White	material	reflects	80	per cent	of	incident	light
Light Pink	"	"	35	"	"	"	"	"
Green	"	"	18	"	"	"	"	"
Dead Black	"	"	1	"	"	"	"	"

This explains the difference in foot-candles obtaining in the same set of show windows, where a display of white goods will give good results and a window 20 feet further along, showing a line of dark material, will seem dead. This is also shown by the following table of approximate values for proper illumination of show windows:

Show windows with light goods require			8.0	foot-candles	
" " " medium "			16.0	"	"
" " " dark "			20.0	"	"

There are various ways by which to determine the power needed for these windows. The method commonly used for various installations is as follows:

$$\text{Watts required (Total)} = \frac{\text{Area (sq. ft.)} \times I}{K}$$

Where the given constant, K, is dependent largely on the color effects, using as a basis—with tungsten lamps, polished surface reflectors, light walls—a constant value for K of 5.0 we have for:

Polished reflector with			dark	walls,	the	value	4.0
Satin finish "	"	light	"	"	"		4.3
" " "	"	dark	"	"	"		3.4

I is the intensity in fcot-candles desired.

Let us discuss the second class of properly lighted show-windows. This is mostly covered by the foregoing remarks. However, we may repeat that which Mr. Porter states, "as a general fundamental rule of good window lighting, that the flux of the light should, as nearly as practicable, follow the line of vision, and that the light sources, should be entirely out of the line of vision, and so placed that the direct rays cannot strike the eyes of the observer, while he is looking at the goods displayed in the window. Following these rules usually requires that the lamps should be located along the upper front corner of the window."

Of the tubular lamps and tungsten filament, it is stated that they are laboring under the disadvantage of being low voltage, and therefore, require transformers or series connections. This is not necessary on the new wire type of lamps. Also, it is stated that the reflectors, as mentioned with this system, are only used to concentrate the light in one direction. This also has been overcome by the designing of various classes of reflectors to be used on any respective classes of installation desired. Various manufacturers are now making all classes of reflectors to accommodate tubular lamps.

PRACTICAL ILLUMINATION.[1]

BY F. B. LEWIS.

Some years ago gas lighting was revolutionized by the advent of the Welsbach mantle, and electric lighting companies became somewhat concerned over their position in the lighting field.

The 3.5 watt carbon incandescent lamp was at that time their only defense, and owing to the low efficiency and yellowish quality of light, the gas light gained considerable ground. The tungsten and other high efficiency lamps were soon after placed upon a commercial basis and regained the vanishing prestige of the incandescent electric lamp.

The advent of these higher efficiency lamps, with their greater intensity of light—or, as it is more properly called, higher intrinsic brilliancy, with the consequent damaging effect upon the eye, together with the ever increasing demand for efficiency, are probably largely responsible for the serious consideration which the subject of illumination has received recently from a scientific standpoint.

In the days of our grandfathers when artificial light had no particular commercial value, but was only considered a convenience, the tallow candle answered their purpose. This had an intrinsic brilliancy (which is the candle power emitted per square inch of projected area) of three. This form of light was superseded by the oil lamp, having an intrinsic brilliancy of six. And we find that as light sources have been improved the intrinsic brilliancy has been increased until as with the flaming arc lamp we have a light source capable of emitting 5000 c.p. per square inch of projected area.

When it is remembered that the human eye can withstand without fatigue but about 5 c.p. per square inch of surface, it is clearly seen what the harmful effect of unshaded modern light sources might be, and the question of eye protection therefore becomes one of great importance.

Table of Intrinsic Brilliancy.

Candle	3
Oil lamp	6
Gas flame	7
Welsbach gas mantle	35
Enclosed A.C. arc lamp	125
Enclosed D.C. arc lamp	150
Carbon incandescent lamp	375
Gem incandescent lamp	625
Tungsten incandescent lamp	1000
Flaming arc lamp	5000
Sun at zenith	600,000

In the table shown, it is noted that the tungsten incandescent lamp has an intrinsic brilliancy of 1000, and as this is the outcome of the ever increasing demand for light. the lighting companies soon found that unless the subject of illumination was given some attention by them, considerable harm rather than benefit would result.

By way of explanation, it might be well to point out that lighting consumers have an extremely vague idea of the kw. or unit by which they are charged for the service they receive; and, therefore, are inclined to demand light rather than the energy that produces it. It is, therefore, evident that poor efficiency, or poorly designed installations, reflect upon the lighting company, and as is usually the case, they are compelled

[1]Presented before the Los Angeles Section of the A. I. E. E., Jan. 23, 1912.

to point out to the consumer wherein the fault lies. It may be that the fault is due to dark colors of walls, or hangings, or the use of frosted globes, or the use of improper style of shades or reflectors. These points will be touched upon later.

The increasing demand for light has brought about a demand for greater efficiency in order that the expense of this increase of light shall not be prohibitive.

Light can be controlled, directed or re-directed, similar to most other forms of energy. Light rays travel in straight lines unless absorbed or deflected. Deflection can occur in one of two ways; either by refraction or by reflection. Refraction simply means the bending the light ray, as, for instance—when a light ray strikes a pane of glass at a certain angle its direction is slightly changed in its passage through the glass.

Reflection may be either regular or irregular. Regular reflection occurs when light strikes a smooth surface, such as a mirror, and is reflected as a sharp beam. The angle at which it strikes the mirror being equal to the angle at which it is reflected.

When, however, light strikes a rough surface, whether polished or unpolished, the light is reflected in all directions, causing what is called, irregular or diffused reflection. This, in the case of a piece of glazed writing paper resting on the desk, we often find a glare from the paper, which is caused by the concentrated reflection; but if this glazed paper be replaced with blotting paper, the glare will disappear, due to the rough surface of the latter, and the resulting diffused reflection.

Different colors absorb or reflect different percentages of the light, and it is for this reason that a room which is papered with a dark color has the appearance of being poorly lighted, whereas the same candle power of lamps, by simply changing the wall paper for a light shade, will make the room appear much brighter.

	Per cent.
Mirror reflects	95
White paper	82
Yellow	40
Pink	36
Blue	25
Green	18
Dark brown	13
Red	12
Black paper	0.5
Deep chocolate	0.46
Black velvet	0.4

In the same way, tapestry, burlap and velvet absorb a great quantity of the light. The smoother the surface the more will be the light reflected, as for instance, a tinted wall will reflect more than a wall covered with wall paper. Glass also absorbs light.

	Per cent.
Clear glass absorbs	10
Frosted glass absorbs	30-45
Opal glass absorbs	40-50
Alabaster glass absorbs	50-60

Intensity of light is expressed in candle power, which is simply an expression in terms of light given by a standard candle. To measure the candle power of a light source a screen is placed between this light source and a standard candle, or a lamp that has previously been standardized by the candle, and it is moved to a position that obtains equal brightness on both sides of the screen. The intensity varies inversely as the square of the distance of the light sources from the screen; as, for instance, if the standard candle measures one foot from the screen and the lamp to be tested measures four feet, its candle power will be four squared or sixteen. In this way it is also possible to determine the candle power which a lamp gives in each direction, in other words; determine its photometric curve.

It is thus found that all ordinary incandescent lamps give the most light in a direction at right angles to the length of the lamp. In fact, while the common 16 c.p. lamp gives 16 c.p. in this direction, it gives but 6.6 c.p. at the tip, the direction in which the light is most needed when the lamp is hanging vertical, as is usually the case. It is evident, then, that a bare lamp like this hung in a room, will throw the maximum amount of light on the walls of the room, and only 40 per cent of this amount of light down, where, in nearly every case it is most needed. This readily illustrates the necessity of using reflectors to change or redirect the rays of light as given off by the lamps, and reflect them where they are of the most use.

If this same lamp be equipped with a concentrating prismatic reflector, such as the Focusing Holophane, the candlepower in the horizontal direction will be 7, and in the downward or vertical direction, 57. This reflector is suited to all locations where concentrated light is desired at one point, without distribution over a wide area; for instance, in show windows or in halls or very small rooms having high ceilings.

Other types and designs of reflectors control the light in a similar manner, but redirect it through wider or narrower angles, and it is necessary to know the area that is to be lighted, and the height above the floor that the lamp may be hung before the proper selection of a reflector can be made.

Effective illumination is usually that part which is directed downward and not to exceed 60 degrees from the vertical. As an example, a bare 60 watt tungsten lamp will furnish a flux of light in a direction between 0 degrees and 60 degrees from the vertical of 86.8 lumens. This same lamp equipped with an intensive reflector will furnish 221 lumens, or a gain in effective illumination by the use of the reflector of 155 per cent.

The size and number of lamps or total candle power required depend upon three things: First, the intensity of light required for the room to be lighted; the type of reflectors to be used, and the color of the walls and ceiling of the room. One is no less important than the others. Intensity of light has for its unit the foot-candle, or the illumination produced on a surface one foot distant from a light source of one candle power. Since light varies inversely as the square of the distance, a 16 c.p. lamp will give an illumination of one foot-candle on a surface four feet from the lamp. The foot-candle intensity required to give satisfactory results depends upon the class of service and varies from 0.1, for the residence street lighting, to 20.0 for show windows. Again, stores and show windows on an active business street in a large city must have higher illumination than in small towns where there is less competition or rivalry in display lighting. With indirect or

concealed lighting, and with direct lighting from extremely high ceilings, higher intensities must be allowed than with direct lighting from usual ceiling heights.

In the past, and largely at the present time, the designing of lighting schemes has been handled solely by the architect, but on account of the increasing importance of this phase of engineering, it is becoming recognized as a profession. However, it is so closely affiliated with the architecture, that it should be handled jointly.

THE BURNING OF POLE TOPS.

The Washington Water Power Company has encountered a peculiar trouble in the burning of pole tops. Upon testing the insulators from these burned poles no punctures are revealed and the only solution to be suggested is that the heat from the charging current has started a smoldering fire in the poles and grounding of the pins has been resorted to. Whether or not this will prove to be the desired remedy time only can tell—as no similar work has been done heretofore.

JEWEL BEARING FOR ELECTRIC METERS.

Cup diamond jewels are being used by the Seattle Electric Company in all large direct current meters and in some of the small direct current meters working on a high-load factor. The results have been highly satisfactory, the life being about five times the life of the sapphire jewel. Owing to dissatisfaction with the results obtained with sapphire jewels in induction meters, the company last year purchased 1400 induction meters with diamond jewels. However, they have not been in service a sufficient length of time to determine what length of life can be expected of them. The flat diamond with a ringstone sapphire guide has not proven satisfactory.

THE USE OF LIGHTNING ARRESTERS AROUND PUGET SOUND.

In the Puget Sound territory lightning arresters do not ordinarily function in accordance with their name. Lightning is exceedingly rare as shown by a report of the Seattle Electric Company. With but two interruptions due to lightning in over seven years and with damages on each occasion not exceeding $15, it may be wondered for what purpose these appliances are used. They serve to take care of surges set up by switching, short circuits, grounds and other disturbing elements occurring in lines of 13,000 volts. There are several types in use, the most efficient probably being the aluminum cell arrester.

One of these, placed on the bus of a 13,800 volt system, has discharge with each disturbance set up, in spite of the arrangement wherein the surge had to pass back through current transformers and a set of choke coils in the lines. This is a very good record considering that the protection afforded by arresters on a bus is held to be rather doubtful due to the large inductance offered to high frequency surges by the current transformers on each line.

AN IMPORTANT LEGAL OPINION.

Of utmost importance to public service corporations throughout the State of California is the recent legal opinion of John W. Shenk in brief presented to the Los Angeles Council referring to the effect of the repeal of Section 19 of Article 11 of the constitution of the State of California. The matter is entirely self explanatory and is published in full below:

Section 1. From the time of the adoption of the California constitution of 1879 until October 10, 1911, the constitution of the State of California contained the following provision in Section 19 of Article XI:

"In any city where there are no public works owned and controlled by the municipality for supplying the same with water or artificial light, any individual, or any company duly incorporated for such purpose, under and by authority of the laws of this State, shall under the direction of the superintendent of streets, or other officer in control thereof, and under such general regulations as the municipality may prescribe, for damages and indemnity for damages, have the privilege of using the public streets and thoroughfares thereof, and of laying down pipes and conduits therein, and connections therewith, so far as may be necessary for introducing into and supplying such city and its inhabitants either with gaslight, or other illuminating light, or with fresh water for domestic and all other purposes, upon the condition that the municipal government shall have the right to regulate the charges thereof."

The purpose of the foregoing section of the constitution, as disclosed by the record at the time of its submission to a vote of the people, was to permit free and open competition between persons and corporations desiring to engage in the business of furnishing water or artificial light in municipalities and to prevent a monopoly in the furnishing of these utilities. The effect of the adoption of the section was to permit any person or corporation desiring to engage in such business to occupy the public streets of municipalities without obtaining franchises from the city authorities and without hindrance or restriction on the part of local authorities other than that necessary in the proper exercise of the police power. Under that section many companies have been organized and are now furnishing water, gas or electric light to the City of Los Angeles and its inhabitants and occupying and using the public streets of the city for that purpose. The courts, both State and federal, have held that the foregoing section of the constitution was an offer of a franchise and when accepted by persons or corporations properly falling within its provisions contract rights arose between such persons or corporations and the State which were vested and protected by the federal constitution.

On October 10, 1911, the section of the constitution above referred to was amended to read as follows:

"Any municipal corporation may establish and operate public works for supplying its inhabitants with light, water, power, heat, transportation, telephone service or other means of communication. Such works may be acquired by original construction or by the purchase of existing works, including their franchises,

or both. Persons or corporations may establish and operate works for supplying the inhabitants with such services upon such conditions and under such regulations as the municipality may prescribe under its organic law, on condition that the municipal government shall have the right to regulate the charges thereof. A municipal corporation may furnish such services to inhabitants outside its boundaries; provided that it shall not furnish any service to the inhabitants of any other municipality owning or operating works supplying the same service to such inhabitants, without the consent of such other municipality, expressed by ordinance."

By the adoption of this amendment the policy of the State with reference to the control of public service corporations as distinguished from the policy declared by the old section was radically changed. Under the old section any person or company organized for the purpose could occupy the streets of the city without obtaining the consent of the city for the purpose of introducing and supplying to the city and its inhabitants water for domestic purposes, gaslight and other illuminating light. The city has no voice in the occupation and use of its streets for such purposes other than as might fall within the exercise of the police power. The exercise of the police power, however, did not interfere with any substantial right acquired by those who had availed themselves of the provisions of the section. Those rights had become vested and were protected not only by the constitution of the State but by the constitution of the United States. It is true, however, that such rights vested only in behalf of those who had actually availed themselves of the offer extended by the old section and did not inure to those who might, after the amendment, desire to engage in such business. All persons and corporations, therefore, who had not accepted and acted upon the provisions of the old section and who desire to establish and operate works and plants for the purposes enumerated in the old section must obtain permission from the city and establish and operate such works and supply such service only upon such conditions and under such regulations as the city may prescribe under its organic law.

Another and more important question, however, is presented, namely: Has a corporation that has established a system for supplying the city and its inhabitants with fresh water, gas or electric light and occupied certain streets of the city for that purpose prior to the amendment of October 10, 1911, acquired the right under the old section of the constitution to use all the streets of the city, regardless of time, growth of expansion of the city, which were not occupied by such corporations at the time of the amendment.

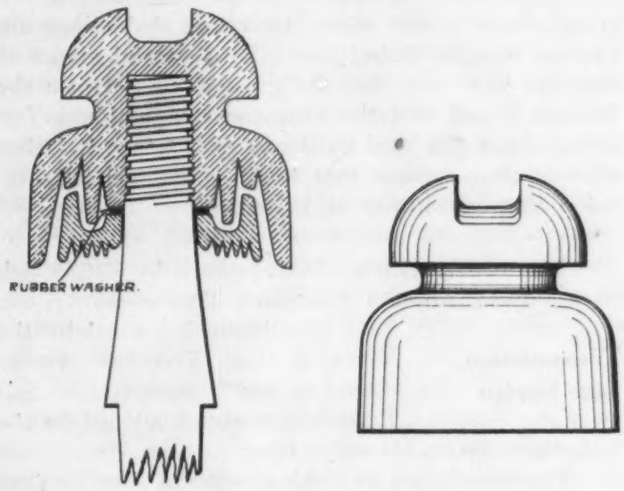
The right acquired under the constitution prior to the amendment by the actual acceptance of its terms constitutes a franchise which is in the nature of an easement in and pertaining to the streets in which the right is exercised. It is inseparably annexed to the streets in the city in and upon which it is exercised and does not, in my opinion, extend further than or beyond the streets actually occupied for the purpose at the time of the amendment. No rights were acquired except in so far as the provisions of the constitution had been accepted, and it is competent for the State at any time to withdraw the offer extended by the section as in force prior to the amendment. A withdrawal of the offer was, in my opinion, accomplished by the amendment which went into effect October 10, 1911. The history of the City of Los Angeles, especially within recent years, evidences a great territorial expansion and a corresponding increase in mileage of streets. A like expansion and increase will undoubtedly take place in the future. In my judgment it can not be successfully contended that the mere establishment of a works or plant and a distributing system in connection therewith vested in the grantee the right for all future time to use all of the streets of the city not occupied on October 10, 1911, or that the scope of the right acquired was measured by the terms of the offer and not by the extent to which it had been accepted. If any serious doubt might exist as to the rights in this connection of the utility corporations under the amended section those doubts under a familiar rule of construction would, in my opinion, be resolved most strongly against the corporations and in favor of the public. My conclusion is that the corporations acquired rights under the old section only in the streets of the city which were actually occupied and used at the time of the amendment and that as to streets not so occupied and desired for use by the utility corporations the consent of the city must be applied for and obtained in accordance with the provisions of the section as amended.

How then is the city to grant the right to the utility corporations to use the streets which were unoccupied prior to the amendment? The amendment to the constitution provides that persons or corporations may establish and operate such works and supply such service upon such conditions and under such regulations as the municipality may prescribe under its organic law. The charter of the City of Los Angeles is its organic law. Subdivision 40, Section 3 of Article 1 of the charter provides that no franchise, right or privilege, in, on, through, across, under or over any streets or other public place, and no other franchise what ever granted by the city to any corporation, association or individual shall be granted except by an ordinance passed by a vote of two-thirds of the whole council nor for a longer period than twenty-one years, etc. Subdivision 46 of the same section provides that the city shall have the right and power to grant franchises or privileges in, on, through, across, under or over any street or other public place and to prescribe the terms and conditions of any such grant and to prescribe by ordinance the method of procedure for making such grants, subject to the limitations elsewhere contained in the charter. The matter of granting rights and privileges in the streets for the purposes, among others, of laying pipes and conduits and erecting poles and wires on the streets is therefore under the law a matter of regulation in accordance with the provisions of the charter. In conformity with the amendment to the constitution and the charter provisions above referred to, the city has by ordinance prescribed a method of extending water mains, gas mains and electric light lines in streets which were not actually occupied and used at the time of the amendment to the constitution. An application for the privilege so to do should be filed and a franchise therefore granted

in accordance with the charter and the ordinances of the city prescribing the method of procedure in the premises. I recommend that the Board of Public Works be instructed to issue no more permits for the laying of water mains, gas mains, or the erection of electric light poles and wires in streets not actually occupied by the utility corporations for the respective purposes contemplated by the constitution prior to the amendment unless the applicant therefore has a franchise duly granted for that purpose. And I further recommend that the utility corporations affected be notified by the clerk that franchises for said purposes should be obtained in accordance with the charter and ordinances of the city.

BETTER INSULATION.

From the first days of the telegraph, more than sixty years ago, it has been the aim of the transmission companies to find an insulator that would remain an insulator in good weather and in bad. Up to the present time it has been the expectation that during a drizzle or a fog, the wire facilities would be materially lessened owing to leakage and the cross-fire that takes place on every crossarm.



Type of Insulator Used in Test.

Now comes the "Noleak" insulator, in which the under part, that is the petticoats, and the space between the petticoats, is protected from dust and moisture. A dry clean space is always present between the conductor and the pin. This effectively stops the leakage that must always obtain with the ordinary insulator when it becomes dirty.

About two years ago the Journal made mention of this new insulator, and in view of the importance of improved insulation it now takes pleasure in giving the results of a test of twenty-eight months on 71 miles of line through a fog belt along the coast of Southern California.

After five months use the following report was made:

"The difference in the actual working of the two wires was very noticeable. No. 2 was very heavy and San Diego had difficulty in adjusting, while No. 4 (equipped with "Noleak" insulators) was clear and could have been worked at high speed."

After seventeen months' use the conditions were stated thus:

"Since the installation of the "Noleak" insulators there has been a great improvement in the working of the two wires. The cross-leak has been reduced to a point where it does not trouble us, and the two wires have been simultaneously workable. Normally the wire insulated with the "Noleak" insulator shows from one-fifth to one-half the escape of the other wire. The elimination of the cross-leak, however, is the best achievement of three insulators, and I believe it is only fair to give them full credit, as the cross-leak has certainly been eliminated since the "Noleak" insulators were put on."

After twenty-eight months' service this statement was given:

"The conditions are practically the same as when I wrote you a year ago."

The chief object sought for by the designer of this insulator, L. W. Storror, who has been prominently identified with the telegraph and telephone service on the Pacific Coast for many years, was to overcome the leakage and cross-fire which threw the greater portion of the lines in the fog belts out of commission every time there was a fog or a drizzle. How successfully this object has been accomplished is shown by the foregoing records.

A more recent series of tests, extending over a period of six months, has just been made. In July, 1911, one pair of aerial wires across Goat Island was equipped with new standard D.P. Insulators, and another pair of wires was equipped with Noleak Insulators. Tests have been made twice a day on seventy-nine days since October 20th, 1911. The lowest measurements of each wire, taken at the same time, indicate that the Noleak Insulator has one hundred and eighty-four per cent greater efficiency than the standard D.P. Insulator.

With this will be found a sketch of the latest pattern of the Noleak Insulator. Eight and one-half inches of insulating surface intervenes between the line wire and the pin, and it is claimed that one-half of this distance will always remain clean and dry.

Insulation experts have declared that sixteen per cent increased distance between line and pin means 100 per cent greater efficiency. The new form of insulator has 25 per cent more insulating distance than the form upon which the tests were made.

MARKET FOR POWER MACHINERY.

There are 2639 industrial establishments in Chile using power machinery aggregating 58,895 horsepower, as follows: 932 steam engines, with 25,312 horsepower, 388 gas engines, with 8494 horsepower; 285 hydraulic engines, with 13,847 horsepower; 112 petroleum engines, with 1332 horsepower, and 922 electric motors, with 9910 horsepower.

It will be seen that here is a field worthy of the attention of builders of power machinery. The tendency is toward hydroelectric machinery and gas and petroleum engines. To date, the greater portion of the power machinery has been supplied by England and Germany, with Germany in the lead. The United States has been gaining some, but there is still a big margin before American interests are getting what would seem a fair portion of the business. Machinery enters free of duty.

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The Great Circle

In the study of elementary geometry we find that a straight line is the shortest distance between two points. Again in the study of solid geometry, the shortest distance between two points upon the surface of a sphere is along the perimeter of a great circle passing through these two points. A great circle is cut out by the surface of a sphere when a plane passes through these two points and the center of the sphere. This law brings about many interesting illusions as to the shortest distance when these two points are two different geographical centers on the surface of the earth. Thus, when a boat sails from one point to another, at first glance we would say that it is heading for the wrong point by compass to gain its ultimate haven, and yet when we come to study the conditions more closely, we find the old sea-captain knows his geography and knows it well, and his good ship is following its journey along the perimeter of a great circle connecting the port he has just left and the port to which he desires to arrive in the shortest time possible. If now we consider the map of the world represented on one of the well known geographer's globes some interesting deductions are at once brought to our gaze. By a careful glance at the map it is seen that the great circle between the Panama Canal and the Orient comes within a few miles of the Coast of California, and hence it is but reasonable to believe that her harbors will be ship-laden from every port in the world.

Transmission Line Design

The leading article of this issue is by Otto Falch on the Design of the Stanislaus Transmission Line. This installation is owned by the Sierra & San Francisco Power Company and transmits into San Francisco power developed on the Stanislaus River, 134 miles away.

The installation of steel towers in the modern hydroelectric transmission plant seems now to have become firmly established. Indeed no longer are the more enterprising power companies contenting themselves with one steel tower transmission line, but now we find the Pacific Light & Power Corporation of Los Angeles proposes to install at once a double steel tower transmission line, 275 miles long, in transmitting power from Big Creek into Los Angeles at 110,000 volts. Each steel tower line is to have two complete sets of wires for three-phase transmission and the twelve wires thus installed will unquestionably be the most pliable in long distance transmission in the world.

In his paper, Mr. Falch shows that the small saving of 100 pounds of steel per tower meant a saving to his company of $10,000. It is then easy to see to what extent careful design is remunerative.

The method of spacing steel towers outlined is both simple and instructive. It illustrates at a glance the ease with which one can properly space transmis-

sion towers after a careful profile of the line has been plotted. At first thought, the use of the standard catenary impresses one with the idea that this would not allow sufficient pliability to the system. Throughout this entire installation, however, the remarkable feature of design is the constant adherence to standard forms. Even in the crossing of San Francisco Bay wherein the most suitable and careful design was considered from every point of view, no deviation has been made from the standard design, although at this point additional height was necessary.

Closely adhering to standard form, the two portions of the towers are of the same make-up and dmensions. Quick repairing in event of emergency is thus assured.

In our next issue will be found the beginning of a series of articles on the Elements of Steam Turbine Operation and Design.

A Gigantic Steam Turbine

Steam turbine installation has during recent years become of highest economy in auxiliary power plant operation.

The advent of practically an unlimited supply of cheap fuel, due to the California oil fields, amounting to a production of nearly eighty million barrels a year, caused many serious minded engineers to speculate as to whether hydroelectric enterprises would not become more costly in operation than the steam generating power plants. The try-out over several years has resulted, however, in the firm establishment of the hydroelectric plant. Nevertheless, the great central stations of the Coast are finding it imperative to their needs to have steam auxiliary apparatus which can be thrown into complete generating synchronism at a moment's notice.

Unlooked for demands for immediate power consumption, and continuity of service seem to be completely met with the rapid advance of the steam turbine. Hence it is that we find up and down the Coast, situated in the great centers of power consumption, enormous steam auxiliary plants kept in the prime of condition, ready at the first ring of the despatcher's phone, to assist their hydroelectric brothers in carrying their burdens should the occasion arise.

Los Angeles, Oakland, San Francisco, Portland Seattle and Spokane all seem to have felt the need for this design of auxiliary apparatus. It is interesting to note to what gigantic proportions they have grown almost in the moment. But a few years ago a group of reciprocating units of say 2500 h.p. was the wonder and admiration of all observers. Today, however, the small and modest turbine is seen in the modern power plant occupying a space almost inconceivable for its smallness in comparison to the formerly installed reciprocating units. As one enters the generating station where reciprocating units are still maintained and also some of the more recent design of turbine is installed, the contrast between the two is the striking feature. Row after row of reciprocating units, grinding out their mournful supply of energy, is a forceful opposite to the trim, even, and non-obtrusive appearance of their sister unit, the steam turbine.

This even uniform appearance of the turbine is most strikingly borne out in its operation. Steadiness and continuity of service is the cry of the operating manager. The ease with which such enormous concentrated energies are put forth, when desired, has won for the turbine a unique position in the modern power plant.

Most impressive is this gigantic concentration of energy generation. Within the last few days the Pacific Gas & Electric Company of Central California has installed and put into operation the largest steam turbine on the Pacific Coast. The turbine is located at Station A in San Francisco and has a rated capacity output of 15,000 kilowatts or 20,000 h.p. Such statements of power rating do not convey to the average reader the enormous energy that is being developed by this modern Titan.

Perhaps we can get a better conception of the prodigious electrical supply which is capable of being generated by this monster when we say that a string of horses, six abreast and seven miles long, working to their utmost could but equal the energy of this single, modest unpretentious, cylindrical-shaped mechanism. Indeed, could we neglect for the minute the question of line drop in the wires, this one unit would be capable of lighting a string of 16 candle power lamps placed only 220 feet apart that would encircle the globe. A great white way stretching from Yellowstone Park, through Spokane, Seattle, San Francisco, Yosemite Valley and Los Angeles with a double row of lights, 25 feet apart, could similarly be lighted. So far as power is concerned our novelty managers of the Panama-Pacific International Exposition could, by means of this turbine, generate sufficient energy to deliver a sightseer to the moon and back every three minutes.

For years the advance of the steam turbine was hindered, due to the fact that, for maximum efficiency, speeds approximating 25 miles a minute were necessary. The modern inventor has, however, overcome this difficulty. The steam within the turbine cylinder is now expanded through several stages, six in the case of the turbine above referred to, and the consequence is, that maximum efficiency is obtained at far lower speeds.

It is interesting to note, that if an observer were perched upon one of the tiny buckets in the periphery of this present monster turbine, he would pass through a distance of some six miles a minute and could be hang on for three days he would outdo Nellie Bly in her classic foreign visitations, for in this brief time he would travel a distance equal to a trip around the whole world.

Such concentrated powers are for the human mind almost unconceivable. To this massing of energy-generating mechanisms, nevertheless, unquestionably points in approval the index finger of modern power plant economy.

PERSONALS.

W. D. Thomas, an electrical contractor of Petaluma, was a recent San Francisco visitor.

J. W. Ricketts, electrical engineer at Chico, Cal., was in San Francisco during the past week.

C. L. Cory, electrical engineer, has returned to his San Francisco office from Los Angeles.

R. F. Chevalier, consulting engineer of San Francisco, has spent the past week in Portland, Oregon.

Thomas Mirk, of Hunt, Mirk & Co., has been visiting Los Angeles and San Diego on engineering business.

Leon M. Hall is engineer for the Mono Power Company and other projects financed by the Adams interests.

Harry Hays, purchasing agent of the Mt. Whitney Power Company, is among the recent arrivals at San Francisco.

Frank H. Ray, of New York, who is interested in the Great Western Power Company, is a San Francisco visitor.

C. T. Phillips, illuminating engineer, has returned to San Francisco after a business trip through the interior of the State.

J. J. Davis, vice-president of the Santa Monica Light & Power Company, is among the recent arrivals at San Francisco.

Charles Froding, agent for the Foster superheater and a garbage destructor, is in Arizona superintending a new installation.

A. M. Hunt, who is touring Egypt, was on the Upper Nile when last heard from. He will remain abroad for several months longer.

John S. Baker, district manager of the Crocker-Wheeler Company, has returned to his San Francisco office after spending a week at Los Angeles.

H. Wolfe, who was formerly connected with the Levy Electric Company, has joined the sales force of the California Electrical Construction Company.

C. E. Patton, Pacific Coast manager for the Central Electric Company of Chicago, passed through San Francisco during the past week on his way North.

O. G. Steele, superintendent of the Siskiyou Electric Power and Light Company, with headquarters at Eureka, spent the past week at San Francisco.

G. C. Holberton, manager of the San Francisco District, of the Pacific Gas & Electric Company, recently visited Grass Valley, Nevada City and surrounding territory.

Charles C. Hillis, manager of the San Francisco house of the Electric Appliance Company, is on his way East and will spend about two weeks in visiting the factories at Cleveland and elsewhere.

Edson F. Adams has returned to Oakland after spending a month in the East and it is expected that the work on several hyydroelectric developments, in which he is interested, will go forward rapidly.

B. B. Beckett has been appointed manager of Pierson, Roeding & Co.'s office at Seattle, in place of R. H. Husbands, resigned. Beckett was formerly chief engineer of the firm with headquarters at the San Francisco office.

F. G. Baum, who has been the partner of W. P. Hammon in the ownership of the electric power and traction system at Monterey and Salinas, which is reported to have changed hands again, has returned to San Francisco from Monterey.

H. E. Adams, who has been manager of the Western States Gas and Electric Company's interests, with headquarters at Stockton, since H. M. Byllesby & Co. entered California, has resigned and has been succeeded by W. S. Butler, who has assumed general control.

A. E. Barlow, who is now general sales manager of the American Ever Ready Company on the Pacific Coast, is making a business trip through the Pacific Northwest.

W. E. Barrett, the gas engineer of J. G. White & Co., has returned to Los Angeles after an Eastern trip on business connected with the construction of the Midway Gas Company's pipe line for natural gas.

Sidney Sprout has returned to Siskiyou County after spending a week in San Francisco, receiving bids for a 10,000-kw. hydroelectric plant for the Siskiyou Electric Light and Power Company. The specifications call for one horizontal 10,000-kw. 3-phase 60-cycle generator and a direct-connected turbine water wheel to operate under a head of 130 feet. An independent exciter set and some transformers are also to be purchased.

P. M. Hunt, of Hunt, Mirk & Co., is at Tulare starting work on the new electric power installation of the Tulare County Power Company. The boilers are on the ground and a 1500-kw. steam turbine plant will be installed so as to transmit current at 11,000 volts over a large area of farming land surrounding Tulare. Power will be furnished for irrigation, pumping, lighting, etc. C. H. Holley, who was formerly with the Mt. Whitney Power Company, is consulting engineer and has an interest in the new company. Its water rights in the mountains will be developed.

EELECTRICAL CONTRACTORS' NOTES.

The strike that has been carried on in San Mateo for the past nine months has been settled and every one is happy again.

Secretary Hanbridge of the State Contractors' Electrical Association, reports business good in Sacramento and Stockton.

Mr. Glenn Arbrogast, Los Angeles representative of the Newberry-Benheim Company, was in San Francisco last week on business.

C. V. Schneider, manager of the Electric Supply Company of Sacramento, has been in San Francisco attending to business.

H. Reid, manager of the Pacific Extinguisher Company, has returned to San Francisco from Portland after a two weeks' business trip.

The Newberry-Benheim Company has just been awarded the wiring contract for the Stanford Memorial Church at Palo Alto, for the sum of $2900.

The Levy Electric Company was awarded the electrical work for the five story hotel at Sacramento and Drumm streets for the sum of $2200. Shea & Lofquist are the architects.

M. Jacobs, a contractor from Santa Rosa, E. Bogie, a contractor from San Rafael; F. Somers, a contractor from San Jose, were in San Francisco during the past week and attended the Development League meeting.

Wm. J. Nixon has been appointed chief of the Department of Electricity of San Francisco. Mr. Nixon was chief prior to the old administration and won the confidence of the electrical people by the manner in which he attended his duties. The contractors are well pleased, as they know he will give them all a fair deal.

W. S. Hanbridge, secretary of the State Association, attended a meeting of San Jose Local No. 9 recently. Arrangements were started for an entertainment of the contractors, their families and friends for the State Convention in August. A fine time is promised and it is hoped that all of the electrical fraternity will arrange their vacations so as to be the guests of the San Jose contractors. Mr. Hanbridge reports that in the history of the organization it was never in better shape.

INDUSTRIAL

O-B LOCK HANGERS.

The Ohio Brass Company is listing several forms of round top hangers with a locking feature for giving, at all times, a tight joint between the hanger body and the boss of the trolley ear.

The locking feature is obtained by inserting a non-rotatable stud and a spring washer in a cup casting which is swaged over an anchor casting moulded into the insulation, thus anchoring the whole firmly in the outer body casting. The stud has a limited vertical movement in opposition to

O-B Lock Hanger

the lock washer and therefore, it is possible to screw the trolley ear onto the stud until the top of the boss on the ear is in contact with the cup casting of the hanger and then continue rotating the ear until it is in alignment with the trolley wire. This continued rotation, after the first contact, causes the lock washer to be compressed and this condition guarantees a tight joint at all times, thus eliminating vibration between the stud and ear boss and preventing the wearing out and stripping of threads.

The hanger can be furnished with ⅝ inch stud and in two sizes of the form shown in the accompanying illustration and with a ¾ inch stud in the form having the clips on the out-riggers turned upward.

LOS ANGELES ELECTRICAL LEAGUE.

The weekly luncheon of the Electrical League was held Thursday, January 18, in Los Angeles. For the coming year R. H. Manahan, city electrician, was elected president; H. B. Woodill, of the Woodill & Hulse Electric Company, vice-president; R. B. Clapp, of the Westinghouse Electric Manufacturing Company, secretary-treasurer; Mr. Kister of the Los Angeles Gas & Electric Corporation, director, and Mr. Childs of the Southern California Edison Company, director. Committees for the different functions will be appointed later.

TRADE NOTES.

Frank R. Wheeler, formerly San Francisco and Chicago manager of the C. H. Wheeler Manufacturing Company, and R. B. Guernsey announce their association as the firm of Guernsey & Wheeler, with offices in the Rialto Building, San Francisco. They are district managers for American Blower Company, Kerr Turbine Company, Warren Webster & Co., C. H. Wheeler Manufacturing Company, Vacuum Engineering Company, Uehling Instrument Company.

The Westinghouse Electric and Manufacturing Company has sold the Oakland and Antioch Railway Company a 750-kw. synchronous motor-generator set which is to be installed in a new sub-station on the line of the new electric road. Power will be taken from the Great Western Power Company and direct current at 1200 volts will be generated for the railroad. A 50-ton Westinghouse electric locomotive will be delivered in the spring.

ANNOUNCEMENT BY GREAT WESTERN POWER CO.

The Great Western Power Company announces that to fill the vacancy caused by the death of Edwin Hawley, Mortimer Fleshhacker has been elected president, and A. W. Bullard, vice-president. Mr. Bullard will reside in San Francisco, and will be actively associated with Mr. Fleshhacker in the management of the company's affairs.

The company also announces that through an underwriting of securities which it had available, $2,850,000 has been provided for the extension and development of its properties. This money is immediately available and will care for the company's financial needs for more than a year.

It is expected that the Dam at Big Meadows, for impounding more than 1,000,000 acre feet of water, will be completed during the dry season of 1912. All of the preliminary work has been done this year.

The cable under the bay of San Francisco has been laid and is in successful operation and electric current from the hydroelectric plant, 175 miles from San Francisco on the North Fork of the Feather River, is being successfully delivered to the customers of the company's subsidiary, City Electric Company, in San Francisco. Very substantial savings in operating expenses accrue from the use of this hydroelectric power, and in addition, the large steam plant at the foot of Mason street is rendered available as a reserve to insure continuity of service for the company's customers both in San Francisco and across the bay.

An additional 20,000 kw. generating unit will probably be installed in the Big Bend power house on the North Fork of the Feather River during the coming summer. This will increase the capacity of that station to 60,000 kw. which is equivalent to 80,000 horsepower. The rapidly developing business of the company would seem to warrant this addition to its generating capacity.

Great confidence is felt by the management of the company in the development of the Sacramento Valley and the bay region, including San Francisco, and it is believed by them that extensive preparations must be made for the very large demands for power already in evidence and to develop in the next three or four years.

BOOK REVIEWS.

Telephony. A comprehensive and detailed exposition of the theory and practice of the telephone art. By Samuel G. McMeen and Kempster B. Miller. Size 6½x9½ inches; 948 pages; 671 illustrations; durable cloth binding. Published by American School of Correspondence of Chicago and for sale by the Technical Book Shop, 106 Rialto Bldg., San Francisco. Price, $4.00.

on telegraphy. The authors, the unquestioned leaders in telephone engineering of today, have put into its pages numbering nearly a thousand, the very best that there is in the art. The illustrations are clear and to the point and bear the stamp of uniformity which make the book of unusual clearness for the beginner. The reader is first taken through a preface alive with human pulsation, then into the book proper, the introduction of which touches interestingly on a brief history of the development of the art of telegraphy. From the simple laws of acoustics, the electrical reproduction of speech, he is finally step by step taken in simple thought throughout the labyrinth of intricacies involving a mechanism and its use which today numbers one for every twelve people in the United States. It is needless to go into all the hundreds of separate discussions met with in this production, suffice it to say, if you want a book on telephony you can not afford to be without this one.

NEWS NOTES

INCORPORATIONS.

SAN FRANCISCO, CAL.—The Midland Counties Gas & Electric Company has been incorporated at $1,000,000, with shares at $100 each. Five hundred dollars has been subscribed by W. A. Nunlist, J. J. Welch, P. W. Webb, J. A. Williams and W. C. Crittenden.

BOISE, IDAHO.—A new power company is being organized for the purpose of making power on the Payette and Snake rivers for consumption in Boise. An engineer has been employed to make surveys and estimates of the costs of developing power at the two sites which the company has in mind. The company is to be capitalized at $1,000,000.

ILLUMINATION.

HUNTINGTON, ORE.—A franchise has been granted to the Oregon-Idaho Light & Power Company for an electric plant, which will render light, power and heating service.

BEND, ORE.—Henry Linster has petitioned the County Court for franchises for a water and electric system in Aubrey Heights, which is on the west side of the river from Bend.

SONOMA, CAL.—Messrs. Evans & Brooke of the electric light company are getting long term contracts from the consumers of the valley. This company expects to enlarge their plant and rebuild all of their lines.

PORTLAND, ORE.—Mayor Rushton is endeavoring to eliminate from Portland all storage tanks for oil, and to allow only distribution tanks in the "East Side." This would cut down the 750,000 gallon storage of the Standard Oil Company about sixty per cent.

PORTLAND, ORE.—The restraining order of the courts having been removed the Hydroelectric Company has turned its current into the lines entering Hood River. The Hood River Gas & Electric Company has begun a rate cutting war on the former company.

CORONA, CAL.—Sealed bids will be received until March 19 for the purchase of a franchise granting the right to construct and for a period of fifty years to maintain an electric pole and wire system upon all the streets, alleys and thoroughfares of the city.

PLACERVILLE, CAL.—The expenditure of $100,000 on the reconstruction of miles of flume and the employment of about 150 men for several months will be the result of preliminary work now being carried on by a corps of civil engineers for the Western States Gas & Electric Company.

GRANTS PASS, ORE.—The City Council has considered the petition signed by citizens asking for an amendment to the charter to bond the city for $400,000 for a water and light system; and after some discussion the matter was referred back to the petitioners for investigation and correction.

SANTA ROSA, CAL.—The Great Western Power Company will enter this field in active competition with the Pacific Gas & Electric Company on July 1. An application will be filed with the Supervisors for a franchise to construct lines over the county roads. It will necessarily be a blanket franchise, covering practically all the roads of the county.

FALLS CITY, ORE.—A guy wire short circuited the high tension wires from the power house and blew the transformer fuses. The governor on the water wheel stuck and the wheel ran away, wrecking the generator. When the accident happened the attendant was out of the station, shutting down flood gates at the dam. The town will be without lights for about two weeks.

OAKLAND, CAL.—The Central Oakland Company is to invade the residence districts of the city with a cut of the light rate from 7c to 6c. This is the newest move in the triangular rate war in Oakland. the three parties to which are the Central, the Great Western and the Pacific Gas & Electric. Meanwhile the Great Western Company is offering power to manufactories along the estuary. The light and power rate war started with the entry of the Central Oakland Company to the business section. Previous rates for light and power tumbled at once, first in a cut by the new company, then in a retaliatory reduction by the older corporation, the Oakland branch of the Pacific Gas & Electric Company. Nine-cent charges were reduced to 7c, and in the district where power was supplied, some services were sold as low as 1c.

LOS ANGELES, CAL.—Declaring the functions of a county board of equalization to be judiciary and not assailable in the courts unless so warranted by evidence of fraud, the State Supreme Court has reserved the decision of the Superior Court of Los Angeles County, which repaid to the Los Angeles Gas & Electric Company $11,278.12, State and county taxes paid under protest. The gas company had alleged that this sum represented the excess taxation upon its property demanded by the assessor, and that the assessor not only over-valued the property, but discriminated against the concern. The trial court found that there had been certain discrimination on the assessor's part. The gas company, however, had protested to the Board of Equalization, and the board had declined to reduce the amount. For this reason, rules the Supreme Court Justices, the company must pay the amount upheld by the board.

LOS ANGELES, CAL.—The Supervisors have decided to offer for sale the franchise authorizing three sixteen-inch pipe lines to convey natural gas from the Midway oil field to Los Angeles. The expected battle between the Midway Gas Company and the Los Angeles Gas & Electric Company with respect to the franchise did not materialize. The franchise provides that the successful bidder must put up a $25,000 bond and that the work must be finished in three years. The whole project will cost $1,500,000, of which $200,000 must be expended six months after the sale of the franchise. The time of duration of the franchise is 40 years. The pipe line is to follow the aqueduct as nearly as possible to San Fernando alredy arranged for the entire output of the gas wells and thence to the city limits. The Midway company has already arranged for the entire output of the Honolulu Consolidated Oil Company in the Buena Vista Hills district of the Midway oil field, and is understood to control considerable natural gas production nearer home.

TRANSMISSION.

SACRAMENTO, CAL.—Edward Whaley, secretary of the Northern California Power Company has confirmed the rumored purchase by his company of the Sacramento Valley Power Company, but reserved a statement as to the price and terms of purchase until certain legal steps, which are necessary to complete the deal, have been taken. The Sacramento Valley company was organized two years ago by Herbert and Mortimer Fleishhacker and their associates by the consolidation of several smaller companies and has proven an aggressive competitor for the light and power business of the northern counties. Talk of a merger by purchase has been current for some time, and officials of both companies have now confirmed the statement that the terms have been agreed upon and that only the legal transfer remains to be attended to.

BANDON, ORE.—The Bandon Water Company has taken over the holdings and franchises of the Bandon Light & Water Company and has elected the following officers: President, E. E. Johnson; vice-president, L. H. Hazard; secretary-treasurer and manager, Geo. Laird. The firm has outlined extensive improvements to be soon under construction, among which are new reservoirs, three dams and about 1300 lineal feet of flumes, with over 5000 cubic yards of excavation, the laying of several thousand feet of pipe, tile drain, etc. The plans include a clear-water reservoir of 3,000,000 gallons capacity and two settling reservoirs of 5,000,000 gallons capacity. The plans for this work were prepared by L. F. Blaz, civil engineer.

TRANSPORTATION.

PORTLAND, ORE.—Six suits are pending to condemn a right of way for the Albany-Eugene extension of the Oregon Electric.

PASADENA, CAL.—The Pacific Electric Railway Company has been granted a franchise to construct and operate an electric railway upon Washington street.

BURLEY, IDAHO.—Petitions are being circulated among settlers to request the County Commissioners that they grant to Albert Pleoger and associates a franchise for the purpose of building electric railroads.

LEAVENWORTH, WASH.—Bonds to the amount of $1,000,000 for the purpose of constructing the electric line from Wenatchee to Leavenworth, have been sold, according to Mr. Folt of the Wenatchee Valley Railway & Power Company.

SACRAMENTO, CAL.—Business on the line of the Central California Traction Company has increased 75 per cent during the last year, says Geo. W. Peltier, vice-president of the line. The first month of the line's second year has just been checked up and the discovery made that business has almost doubled.

SAN BERNARDINO, CAL.—The Southern California Edison Power Company has awarded a contract to S. Starkweather for the construction of a power line. From a point near Colton it will pass south of Bloomington, through Chino Valley and tie in with the line near Los Angeles. The contract price given is $12,500.

ALBUQUERQUE, NEW MEXICO.—Valley farmers have signed contracts for the building of a power line six or seven miles down the valley on the east side of the river, to carry electricity sufficient to irrigate land along the route. Work will be started at once and will be completed about March 15, if favorable action is taken at a meeting of the farmers this week.

OGDEN, UTAH.—The Ogden Rapid Transit Company has applied for a franchise to build an electric car line on the county road in Ogden Canyon, over the territory occupied by the Oregon Canyon Resort Company. It is understood by the Commissioners that the Rapid Transit Company desires to extend its interurban line from the Hermitage in the canyon to Huntsville.

FRESNO, CAL.—Construction work on the railroad to Big Creek from Gordon Switch, five miles from Clovis, has started with a big force of men and teams. The road is being built by the San Joaquin Light & Power Company to transport material to its big power plant, which is under construction. The line, which will pass the Fresno copper mine and connect the mountains with this city by rail, will cost about $75,000.

PORTLAND, ORE.—The Southern Pacific Company is endeavoring to have the council pass an ordinance allowing them to electrify and double track their line on Fourth street. If the ordinance passes the company will immediately electrify and double track both the Yamhill and the Fourth street lines between Portland, St. Joseph, and McMinnville, as well as a connection between the Jefferson street depot and the Fourth street line in Portland. About $1,600,000 has been set aside for this, and as soon as these improvements are completed the work will be extended to Corvallis, Eugene and finally to Salem.

TELEPHONE AND TELEGRAPH.

SANGER, CAL.—An application has been made to the Board of Trustees of the city of Sanger for the purpose of erecting a telephone line for a period of 25 years. The Board of Trustees will receive sealed bids for the sale of this franchise up to March 7th, 1912.

PORTLAND, ORE.—The 16.47 per cent increase in the number of the Pacific Telephone and Telegraph Company phones in Portland, the last year, is the greatest percentage increase on the Coast. San Francisco is next with 11.27 per cent. The number of phones in Portland is now 33,933.

LOS ANGELES, CAL.—The Pacific Telephone & Telegraph Company shows a profit of $1,569 during the year. Its receipts were $1,239,412, including $30,638 for outside tolls. The expenditures were $1,237,846. The plant valuation is reported as $6,839,104, an increase of $793,8811 during the year.

SAN FRANCISCO, CAL.—The Home Telephone Company submitted its report for the year 1911 to the Supervisors this week. It showed that the local plant had cost $6,248,705.92, of which $154,992.53 was for construction last year. The year's revenues from local business were $355,073.43, and $15,058.09 from outside switching, or a total of $370,131.52. The cost of maintenance and operation was $265,880.60.

LOS ANGELES, CAL.—The Home Telephone Company's report again shows an inability to make receipts meet expenditures. The report shows receipts $1,195,179 and expenditures $1,260,128, showing a loss of $65,000 for the year. But the item of expenditure includes an obsolescence and depreciation charge of $537,835 on a plant valuation of $7,039,626. Long-distance receipts, included in the preceding totals, amount to only $23,636.

LOS ANGELES, CAL.—Thos. Foulkes, of the Board of Public Utilities, has reported to Mayor Alexander that an interchange of service between the Pacific Telephone & Telegraph Company and the Home Company is impracticable. The plan of the city having 25 inter-trunking lines would simply be a makeshift and not a cure. Ideal and economical service can be obtained only by the elimination of one or the other of the companies.

FRESNO, CAL.—Within a short time the telephone line now being built from Clovis to North Fork, Madera County, will be completed. This line is being constructed by H. E. Bigelow, proprietor of a stage line out of Friant to North Fork. As soon as this last piece is finished the line will be connected up and people in Fresno will be able to talk into the mountains. At North Fork and O'Neals the Bigelow line will connect with the forest service telephone lines which extend from Trimmer Springs on the south to El Portal on the north and will thus allow outside communication with the forest service. The government operates about 200 miles of telephone line in the Sierras between Trimmer Springs and El Portal. In the past it has been necessary, in order to communicate with the outside, to use the telephone line of the San Joaquin Light & Power Company, but with the establishment of the new line, which connects with the Pacific Telephone & Telegraph Company lines, the power line will be used only by the power company.

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